

PREFACE

Space radiation health risks are a major factor in planning and carrying out long-term space missions, especially outside of the protection of the Earth's magnetosphere. In support of human missions to Mars, the National Aeronautics and Space Administration (NASA) is currently supporting a substantial research effort to understand the mechanisms underlying the highly efficient induction of biological effects from the high energy and charge (HZE) nuclei component of the galactic cosmic rays. The risks of late effects most notably cancer are of the highest concern, however single particle effects by HZE nuclei are also suspected of posing a risk of cataracts and damage to the central nervous system (1, 2). Based on recent results from the Japanese survivors lifespan studies (3), other risks including acute or chronic non-cancer mortality or morbidity risks from large solar particle events and long-term exposures to galactic cosmic rays are also of concern for the higher doses expected on Mars exploration missions.

Access to charged particle beams on Earth is a critical factor for improving understanding of space radiobiology (4), lowering uncertainties in risk projection models (1, 5), and developing mitigation approaches (2). Because of the high costs of such research and the small population of humans that will enjoy spaceflight, applications of space radiobiology research for improving life on Earth is highly desirable. Insights into risks from single nuclei are an important basic science problem, and are relevant for mechanistic studies of genomic instability, cancer, and aging, as well as elucidation of causative mechanisms for diseases induced by radiation or other environmental insults, and the development of countermeasures to such risks.

On May 16-20, 2004 over 170 scientists from 10 nations met at Port Jefferson and Brookhaven National Laboratory (BNL) on Long Island, NY for the 3rd International Workshop on Space Radiation Research held in conjunction with the 15th Annual NASA Space Radiation Health Investigator's Workshop. More importantly, the Workshop celebrated the occasion of the opening of the NASA Space Radiation Laboratory (NSRL) at BNL, a dedicated facility created under a unique partnership between NASA and the Department of Energy (D.O.E) to study the biology and physics of protons and HZE nuclei. A year after its creation, NASA notified the United States Congress in its 1959 Operating Plan that "radiation in space presents a great challenge to physical and biological scientists", that "Among the cosmic radiations, there are large streams of the nuclei of light and heavy atoms, which can produce untoward biological effects. Their study, utilizing the tools of radiobiology, will provide more information about living processes", and "such studies should include their simulation at ground level". In the intervening 45 years, interest in space exploration and studies of the biological effects of space radiation has grown and several facilities in the US and in other countries have been used for ground based research studies. However, the opening of NSRL marks the first time NASA has invested in a dedicated facility to study the biological and physical properties of HZE nuclei. A special note of appreciation from the international space radiobiology community goes to Dr. Walter Schimmerling, the pivotal force at NASA who dedicated more than a dozen years of service to bring about the official opening of NSRL on October 14, 2003.

This Supplemental Issue of Radiation Research provides important contributions relating basic DNA damage and repair processes to the understanding of the health risks of concern for space flight, studies of biological countermeasures to radiation effects, and applications of charged-particle beams such as protons and carbon nuclei for cancer therapy. NASA has created a summer school for students of space radiobiology held each June at BNL, and is providing support to the Radiation Research Society's Student-In-Training Program. It is hoped that the opening of NSRL, the current well-established community of space radiobiologists, and support for training of new scientists will leave a legacy that will enable the safe exploration of the space within the next few decades, and provide important benefits on Earth along the way.

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